2. Near the Equator the sky is largely clouded and precipitation in excess, apparently, of evaporation, the excess coming from evaporation at higher latitudes. This leads to more or less dilution, decrease of density, and upwelling.

Both these causes, (1) and (2), are well known and generally accepted. There is a third factor, however, contributory to the result which I have not seen mentioned in this connection, namely:

3. The Ekman drift: As first shown by Ekman,[2] in the case of deep water far from land a steady wind produces a surface drift 45° to the right in the Northern Hemisphere, to the left in the Southern, of the direction of the wind with reference to the moving surface. But the velocity of the driving wind is thirty to thirty-five times that of this surface, hence the direction of the wind with reference to the water is substantially the same as its geographic direction. Furthermore, the total momentum of the moving water, mainly less than 50 meters deep, is at right angles to the direction of the wind with reference to the adjacent water. Therefore, since the equatorial winds generally are from the east, and the winds of higher latitudes than 35°, say, from the west, the momentum of the resulting Ekman drift is substantially poleward from low latitudes and equatorward from places beyond about 30° north and south. This force evidently tends to pile up the surface water along the belts between the oppositely-directed winds and therefore is a contributing cause of the continuous sinking of the water in these regions and its equally continuous upwelling along the equatorial belt.

Finally, since on the whole the surface temperature decreases from the Equator toward either pole, while the surface sinking covers rather wide belts centered roughly along latitudes 30° north and south, it follows that, for a considerable distance down, the belts of maximum temperature must recede from the Equator with increase of depth, as shown in the figure.

The surprising distribution of ocean temperature described above is, therefore, for the most part, an interesting meteorological effect.

[2] *Arkiv för Mat. Astr. och Fysik*, 1905.

EFFECT OF LOCAL SMOKE ON VISIBILITY AND SOLAR RADIATION INTENSITIES

By IRVING F. HAND,

[Weather Bureau, Washington, D. C., April 22, 1925]

The dense smoke cloud which covered the northwest section of Washington on the morning of April 7, 1925, was remarkable in so many respects that it is thought worthy of a brief description.

On that date the sun rose in a cloud-free sky with prospects for an excellent day for obtaining solar radiation observations. Heavy frost, a minimum temperature of 32° F., and ice one-half inch in thickness were recorded.

When pyrheliometric readings were first made at 6:40 a. m. the Blue Ridge was plainly visible 50 miles to the WSW. At that time little attention was paid to the rather streaked layer of smoke which overhung the business section of the city, as such layers are of somewhat frequent occurrence. However, this one was rather unusual in that its top was perfectly flat.

Half an hour later it became apparent that the solar radiation observatory, which is located on the American University campus, 5 miles NW. of the Capitol, would soon become enveloped in a smoke cloud. Coincident with the arrival of this cloud at 7:30 a. m., the visibility diminished until at 8 o'clock, the time of maximum covering, it had decreased from 50 miles to three-quarters of a mile.

Observations of the number of dust particles per cm.[3] taken at 8 a. m. and at noon give values of 7,077 and 166, respectively. This former value exceeds by 17 per cent the previous Washington maximum, obtained at the Central Office of the Weather Bureau in January, 1924, while it is nearly three times the previous maximum obtained at the American University. It is approximately the number obtained in the Loop District of Chicago on a moderately smoky day—a statement which means much to anyone familiar with that city. The noon value, 166, is below the yearly average of all observations, and about the mean value obtained with a visibility of 30 miles, which was that noted at the time.

An examination as to the character of the dust particles showed that the first record obtained was composed almost entirely of soot, unconsumed carbon, and other products of combustion; many tiny glassy spheres with an average diameter of about 0.0008 mm. being included in the latter. The particles on the noon record were not only smaller but showed almost no soot.

TABLE 1.—*Distribution of meteorological elements*

Time	Temperature	Relative humidity	Vapor pressure	Visibility	Wind		Clouds, amount and kind
					Velocity	Direction	
	°F.	*Per cent*	*Inches*	*Miles*			
6 a. m.	32	87	-------	50	1	NW.	0
8 a. m.	38	83	0.187	¾	2	SW.	0
Noon	57	20	0.089	30	7	S.	1 Ci.

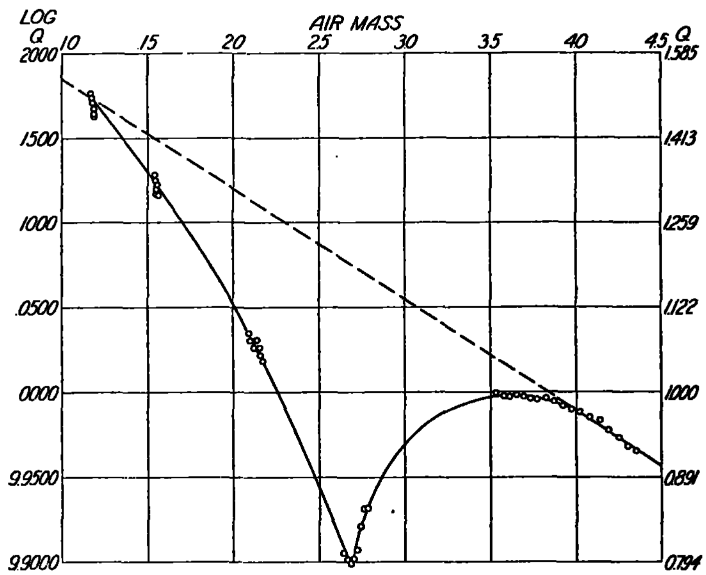

FIG. 1.—Solar radition intensities, American University, D. C., April 7, 1925, showing the effect of local smoke

As will be seen from Table 1, the visibility at noon was but 30 miles as compared with 50 during the early morning, but this is due, in part at least, to greater diffusion of light with increased altitude of the sun and to a background of clouds west of the Blue Ridge.

The curved line on Figure 1 represents the trend of solar radiation intensities measured at normal incidence during the morning of the 7th, logarithms of intensities (log. Q.) being plotted as abscissæ against air mass (approximately the secant of the sun's zenith distance), as ordinates. The broken line has been drawn by interpolation between the first and last series of observations, taken before and after the passage of the smoke cloud, respectively. Extrapolating this to zero air mass we obtain for the value of log. Q., 0.2500, which indicates that the line is representative of what would have been expected with a smoke-free sky.

Table 2 shows not only a decrease of 34 per cent at air mass 2.68, but an actual diminution of 19 per cent with decrease in air mass from 4 to 2.68, a rare occurrence in Washington.

TABLE 2.—*Solar radiation intensities, April 7, 1925*

(Gram-calories per min. per cm.²)

Air mass	Intensities measured through smoke	Intensities from interpolated line	Decrease due to smoke
			Per cent
1.18	1.49	1.49	0
1.58	1.33	1.41	6
2.10	1.08	1.30	17
2.68	0.79	1.19	34
4.00	0.97	0.97	0

Considering that Washington is not a manufacturing city, the localization of this smoke from heating plants, etc., is most unusual; in fact, the smoke cloud was by far the densest ever observed by the writer during the 10-year period he has been stationed at the American University.

SEASONAL PRECIPITATION IN CALIFORNIA AND ITS VARIABILITY[1]

By BURTON M. VARNEY

[U. S. Weather Bureau, Washington, D. C.]

TABLE OF CONTENTS

(This embodies the complete paper, of which Sections V to VIII will be printed as part 2 in the next issue of the REVIEW.)

PART I

I. INTRODUCTION

1. Significance of the relations between precipitation and water supply in California.—Probably in no State in the Union is the water problem more pressing than in California. Without going into extensive detail concerning the intimacy of the relation between rainfall and human activity there, it may be pointed out that the

[1] A dissertation submitted to the graduate board of Clark University, Worcester, Mass., in partial fulfillment of the requirements for the degree of doctor of philosophy, February, 1925.

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